06-19-00

A

Practitioner's Docket No. SJ0000019US1 (IBM1P005) **PATENT**

Preliminary Classification:

Proposed Class:

Subclass:

NOTE: "All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferably class and subclass designations, should be identified in the upper right-hand corner of the letter of transmittal accompanying the application papers, for example 'Proposed Class 2, subclass 129.'" M.P.E.P. § 601, 7th ed.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor(s): Andrew Ching TAM, Chie Ching POON, and Ping-Wei CHANG

WARNING: *37 C.F.R. § 1.41(a)(1) points out:*

"(a) A patent is applied for in the name or names of the actual inventor or inventors.

"(1) The inventorship of a nonprovisional application is that inventorship set forth in the oath or declaration as prescribed by § 1.63, except as provided for in § 1.53(d)(4) and § 1.63(d). If an oath or declaration as prescribed by § 1.63 is not filed during the pendency of a nonprovisional application, the inventorship is that inventorship set forth in the application papers filed pursuant to § 1.53(b), unless a petition under this paragraph accompanied by the fee set forth in § 1.17(i) is filed supplying or changing the name or names of the inventor or inventors."

For (title):

SLIDER CURVATURE MODIFICATION BY SUBSTRATE MELTING EFFECT PRODUCED WITH A PULSED LASER BEAM

CERTIFICATION UNDER 37 C.F.R. § 1.10*
(Express Mail label number is mandatory.)
(Express Mail certification is optional.)

I hereby certify that this New Application Transmittal and the documents referred to as attached therein are being deposited with the United States Postal Service on this date June 15, 2000, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EL624576332US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Erica L. Mann

(type or print name of person mailing paper)

Erica L. Mann

Signature of person mailing paper

WARNING: *Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

"WARNING: *Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).*
*"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.*

1. Type of Application

This new application is for a(n)

(check one applicable item below)

☒ Original (nonprovisional)

☐ Design

☐ Plant

WARNING: ***Do not*** *use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. § 371(c)(4), unless the International Application is being filed as a divisional, continuation or continuation-in-part application.*

WARNING: ***Do not*** *use this transmittal for the filing of a provisional application.*

NOTE: If one of the following 3 items apply, then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED and a NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION.

☐ Divisional.

☐ Continuation.

☐ Continuation-in-part (C-I-P).

2. Benefit of Prior U.S. Application(s) (35 U.S.C. §§ 119(e), 120, or 121)

NOTE: A nonprovisional application may claim an invention disclosed in one or more prior filed copending nonprovisional applications or copending international applications designating the United States of America. In order for a nonprovisional application to claim the benefit of a prior filed copending nonprovisional application or copending international application designating the United States of America, each prior application must name as an inventor at least one inventor named in the later filed nonprovisional application and disclose the named inventor's invention claimed in at least one claim of the later filed nonprovisional application in the manner provided by the first paragraph of 35 U.S.C. § 112. Each prior application must also be:

(i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or

(ii) Complete as set forth in § 1.51(b); or

(iii) Entitled to a filing date as set forth in § 1.53(b) or § 1.53(d) and include the basic filing fee set forth in § 1.16; or

(iv) Entitled to a filing date as set forth in § 1.53(b) and have paid therein the processing and retention fee set forth in § 1.21(l) within the time period set forth in § 1.53(f).

37 C.F.R. § 1.78(a)(1).

NOTE: If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., or benefit of a prior provisional application is claimed, then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

WARNING: *If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. §§ 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. §§ 120, 121 or 365(c). (35 U.S.C. § 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. §§ 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.*

WARNING: *When the last day of pendency of a provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, any nonprovisional application claiming benefit of the provisional application must be filed prior to the Saturday, Sunday, or Federal holiday within the District of Columbia. See 37 C.F.R. § 1.78(a)(3).*

☐ The new application being transmitted claims the benefit of prior U.S. application(s). Enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

3. Papers Enclosed

A. Required for filing date under 37 C.F.R. § 1.53(b) (Regular) or 37 C.F.R. § 1.153 (Design) Application

16 Pages of specification

08 Pages of claims

07 Sheets of drawing

WARNING: ***DO NOT*** *submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to § 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. Only one copy is required or desired. For comments on proposed then-new 37 C.F.R. § 1.84, see Notice of March 9, 1988 (1990 O.G. 57-62).*

NOTE: "Identifying indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page . . ." 37 C.F.R. § 1.84(c)).

(complete the following, if applicable)

☐ The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)." 37 C.F.R. § 1.84(b).

☒ formal

☐ informal

B. Other Papers Enclosed

03 Pages of declaration and power of attorney

01 Pages of abstract

01 Other Correspondence chart

4. Additional papers enclosed

☐ Amendment to claims

☐ Cancel in this applications claims _____ before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)

☐ Add the claims shown on the attached amendment. (Claims added have been numbered consecutively following the highest numbered original claims.)

☐ Preliminary Amendment

☒ Information Disclosure Statement (37 C.F.R. § 1.98)

☒ Form PTO–1449 (PTO/SB/08A and 08B)

☒ Citations

- ☐ Declaration of Biological Deposit
- ☐ Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.
- ☐ Authorization of Attorney(s) to Accept and Follow Instructions from Representative
- ☐ Special Comments
- ☐ Other

5. Declaration or oath (including power of attorney)

NOTE: *A newly executed declaration is not required in a continuation or divisional application provided that the prior nonprovisional application contained a declaration as required, the application being filed is by all or fewer than all the inventors named in the prior application, there is no new matter in the application being filed, and a copy of the executed declaration filed in the prior application (showing the signature or an indication thereon that it was signed) is submitted. The copy must be accompanied by a statement requesting deletion of the names of person(s) who are not inventors of the application being filed. If the declaration in the prior application was filed under § 1.47, then a copy of that declaration must be filed accompanied by a copy of the decision granting § 1.47 status or, if a nonsigning person under § 1.47 has subsequently joined in a prior application, then a copy of the subsequently executed declaration must be filed. See 37 C.F.R. §§ 1.63(d)(1)-(3).*

NOTE: *A declaration filed to complete an application must be executed, identify the specification to which it is directed, identify each inventor by full name including family name and at least one given name, without abbreviation together with any other given name or initial, and the residence, post office address and country or citizenship of each inventor, and state whether the inventor is a sole or joint inventor. 37 C.F.R. § 1.63(a)(1)-(4).*

☒ Enclosed

Executed by

(check **all** *applicable boxes)*

- ☒ inventor(s).
- ☐ legal representative of inventor(s). 37 C.F.R. §§ 1.42 or 1.43.
- ☐ joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.
  - ☐ This is the petition required by 37 C.F.R. § 1.47 and the statement required by 37 C.F.R. § 1.47 is also attached. *See* item 13 below for fee.

☐ Not Enclosed.

NOTE: *Where the filing is a completion in the U.S. of an International Application or where the completion of the U.S. application contains subject matter in addition to the International Application, the application may be treated as a continuation or continuation-in-part, as the case may be, utilizing ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.*

☐ Application is made by a person authorized under 37 C.F.R. § 1.41(c) on behalf of *all* the above named inventor(s).

(The declaration or oath, along with the surcharge required by 37 C.F.R. § 1.16(e) can be filed subsequently).

☐ Showing that the filing is authorized. *(not required unless called into question. 37 C.F.R. § 1.41(d))*

6. Inventorship Statement

WARNING: *If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the last claimed invention was made, should be submitted.*

The inventorship for all the claims in this application are:

☒ The same.

or

☐ Not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,

☐ is submitted.

☐ will be submitted.

7. Language

NOTE: An application including a signed oath or declaration may be filed in a language other than English. An English translation of the non-English language application and the processing fee of $130.00 required by 37 C.F.R. § 1.17(k) is required to be filed with the application, or within such time as may be set by the Office. 37 C.F.R. § 1.52(d).

☒ English

☐ Non-English

☐ The attached translation includes a statement that the translation is accurate. 37 C.F.R. § 1.52(d).

8. Assignment

☒ An assignment of the invention to International Business Machines Corporation (IBM)

☒ is attached. A separate ☒ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

☐ will follow.

NOTE: "If an assignment is submitted with a new application, send two separate letters-one for the application and one for the assignment." Notice of May 4, 1990 (1114 O.G. 77-78).

WARNING: *A newly executed "CERTIFICATE UNDER 37 C.F.R. § 3.73(b)" must be filed when a continuation-in-part application is filed by an assignee. Notice of April 30, 1993, 1150 O.G. 62-64.*

9. Certified Copy

Certified copy(ies) of application(s)

Country	Appln. No.	Filed
Country	Appln. No.	Filed
Country	Appln. No.	Filed

from which priority is claimed

☐ is (are) attached.

☐ will follow.

NOTE: The foreign application forming the basis for the claim for priority must be referred to in the oath or declaration. 37 C.F.R. § 1.55(a) and 1.63.

NOTE: This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35 U.S.C. § 120 is itself entitled to priority from a prior foreign application, then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

10. Fee Calculation (37 C.F.R. § 1.16)

A. ☒ Regular application

CLAIMS AS FILED				
Number filed	Number Extra		Rate	Basic Fee 37 C.F.R. § 1.16(a) ~~$760.00~~ $690.00
Total Claims (37 C.F.R. § 1.16(c)) 37	− 20 = 17	×	$ 18.00	$306.00
Independent Claims (37 C.F.R. § 1.16(b)) 04	− 3 = 1	×	$ 78.00	$78.00
Multiple dependent claim(s), if any (37 C.F.R. § 1.16(d))		+	$260.00	

☐ Amendment cancelling extra claims is enclosed.

☐ Amendment deleting multiple-dependencies is enclosed.

☐ Fee for extra claims is not being paid at this time.

NOTE: If the fees for extra claims are not paid on filing they must be paid or the claims cancelled by amendment, prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37 C.F.R. § 1.16(d).

Filing Fee Calculation $ 1,074.00

B. ☐ Design application
($310.00—37 C.F.R. § 1.16(f))

Filing Fee Calculation $_____

C. ☐ Plant application
($480.00—37 C.F.R. § 1.16(g))

Filing fee calculation $_____

11. Small Entity Statement(s)

☐ Statement(s) that this is a filing by a small entity under 37 C.F.R. § 1.9 and 1.27 is (are) attached.

WARNING: *"Status as a small entity must be specifically established in each application or patent in which the status is available and desired. Status as a small entity in one application or patent does not affect any other application or patent, including applications or patents which are directly or indirectly dependent upon the application or patent in which the status has been established. The refiling of an application under § 1.53 as a continuation, division, or continuation-in-part (including a continued prosecution application under § 1.53(d)), or the filing of a reissue application requires a new determination as to continued entitlement to small entity status for the continuing or reissue application. A nonprovisional application claiming benefit under 35 U.S.C. § 119(e), 120, 121, or 365(c) of a prior application, or a reissue application may rely on a statement filed in the prior application or in the patent if the nonprovisional application or the reissue application includes a reference to the statement in the prior application or in the patent or includes a copy of the statement in the prior application or in the patent and status as a small entity is still proper and desired. The payment of the small entity basic statutory filing fee will be treated as such a reference for purposes of this section." 37 C.F.R. § 1.28(a)(2).*

WARNING: *"Small entity status must not be established when the person or persons signing the . . . statement can **unequivocally** make the required self-certification." M.P.E.P., § 509.03, 6th ed., rev. 2, July 1996 (emphasis added).*

(complete the following, if applicable)

☐ Status as a small entity was claimed in prior application

_____ / _____, filed on _____, from which benefit is being claimed for this application under:

35 U.S.C. § ☐ 119(e),
☐ 120,
☐ 121,
☐ 365(c),

and which status as a small entity is still proper and desired.

☐ A copy of the statement in the prior application is included.

Filing Fee Calculation (50% of **A**, **B** or **C** above)

$_____

NOTE: Any excess of the full fee paid will be refunded if small entitiy status is established and a refund request are filed within 2 months of the date of timely payment of a full fee. The two-month period is not extendable under § 1.136. 37 C.F.R. § 1.28(a).

12. Request for International-Type Search (37 C.F.R. § 1.104(d))

(complete, if applicable)

☐ Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

13. Fee Payment Being Made at This Time

☐ Not Enclosed

☐ No filing fee is to be paid at this time.
(This and the surcharge required by 37 C.F.R. § 1.16(e) can be paid subsequently.)

☒ Enclosed

☒ Filing fee	$ 1,074.00
☒ Recording assignment ($40.00; 37 C.F.R. § 1.21(h)) (See attached "COVER SHEET FOR ASSIGNMENT ACCOMPANYING NEW APPLICATION".)	$ 40.00
☐ Petition fee for filing by other than all the inventors or person on behalf of the inventor where inventor refused to sign or cannot be reached ($130.00; 37 C.F.R. §§ 1.47 and 1.17(i))	$ _____
☐ For processing an application with a specification in a non-English language ($130.00; 37 C.F.R. §§ 1.52(d) and 1.17(k))	$ _____
☐ Processing and retention fee ($130.00; 37 C.F.R. §§ 1.53(d) and 1.21(l))	$ _____
☐ Fee for international-type search report ($40.00; 37 C.F.R. § 1.21(e))	$ _____

NOTE: 37 C.F.R. § 1.21(l) establishes a fee for processing and retaining any application that is abandoned for failing to complete the application pursuant to 37 C.F.R. § 1.53(f) and this, as well as the changes to 37 C.F.R. §§ 1.53 and 1.78(a)(1), indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid, or the processing and retention fee of § 1.21(l) must be paid, within 1 year from notification under § 53(f).

Total fees enclosed $1,114.00

14. Method of Payment of Fees

☒ Check in the amount of $1,114.00

☐ Charge Account No. _____ in the amount of $_____

A duplicate of this transmittal is attached.

NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 C.F.R. § 1.22(b).

15. Authorization to Charge Additional Fees

WARNING: *If no fees are to be paid on filing, the following items should not be completed.*

WARNING: *Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.*

☒ The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 50-0384 Deficiency only (order no. IBM1P005)

☒ 37 C.F.R. § 1.16(a), (f) or (g) (filing fees)

☒ 37 C.F.R. § 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

☐ 37 C.F.R. § 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

☐ 37 C.F.R. § 1.17(a)(1)–(5) (extension fees pursuant to § 1.136(a)).

☐ 37 C.F.R. § 1.17 (application processing fees)

NOTE: ". . .A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

☐ 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

NOTE: 37 C.F.R. § 1.28(b) requires "Notification of any change in status resulting in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying, . . . the issue fee. . . " From the wording of 37 C.F.R. § 1.28(b), (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

16. Instructions as to Overpayment

NOTE: ". . . Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

☒ **Credit Account No.** 50-0384 (order no. IBM1P005)

☐ **Refund**

Larry B. Guernsey

SIGNATURE OF PRACTITIONER

Reg. No. 40,008

Larry B. Guernsey

(type or print name of attorney)

Tel. No. (408) 558-9950

Hickman Stephens Coleman & Hughes LLP

P.O. Address

Customer No.

P.O. Box 52037

Palo Alto, California 94303

☐ **Incorporation by reference of added pages**

(check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an international application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED)

☐ Plus Added Pages for New Application Transmittal Where Benefit of Prior U.S. Application(s) Claimed

Number of pages added _____

☐ Plus Added Pages for Papers Referred to in Item 4 Above

Number of pages added _____

☐ Plus added pages deleting names of inventor(s) named in prior application(s) who is/are no longer inventor(s) of the subject matter claimed in this application.

Number of pages added _____

☐ Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added _____

☒ **Statement Where No Further Pages Added**

(if no further pages form a part of this Transmittal, then end this Transmittal with this page and check the following item)

☒ This transmittal ends with this page.

SLIDER CURVATURE MODIFICATION BY SUBSTRATE MELTING EFFECT PRODUCED WITH A PULSED LASER BEAM

CROSS-REFERENCE TO RELATED APPLICATIONS

Reference is made to U.S. patent application Ser. No. 09/444793, filed 11/22/99, entitled PROCESSING OF MULTI-PHASE CERAMIC SLIDER MATERIALS USING HARMONICALLY GENERATED ULTRAVIOLET LASER RADIATION in the names of Paul M. Lundquist, et. al.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an improved method for the manufacture of sliders for disk drives. More particularly, the invention relates to a method for controllably producing very high crown and camber in the air bearing surface of a slider by applying pulsed laser energy in accordance with the method of the present invention to the back side of the slider in order to induce stress, and thus curvature in the slider material.

2. Description of the Background Art

Magnetic storage disk drives typically include a magnetic sensor called a "head" suspended in close proximity to the

magnetic disk, which serves as the recording medium. In Winchester-type disk drives, a magnetic thin film head is embedded in a ceramic block, called a slider, which is then attached to a flexible suspension. During operation, the rotation of the magnetic disk relative to the slider provides an air-flow along the surface of the slider, which causes it to lift, so that the slider is supported on a cushion of air. This surface of the slider is referred to as the Air Bearing Surface (ABS)and its separation from the disk the Fly Height (FH). The shape of the slider and of the ABS in particular is crucial to the performance of the head. Contours in the ABS establish the desired pressure gradients for positioning the slider above the disk surface. It is therefore typically necessary to form complex contours in the shape of the slider by micro-machining, etching, or other processes to obtain the desired performance.

As more is learned about the dynamics of flying heads, more subtle changes are being required in the shape of the ABS. To implement these refinements, it is becoming more and more desirable to create contours which are complex in three dimensions. Two parameters pertaining to the curvature or flatness of the ABS that are considered important are "crown" and "camber". Crown is the maximum separation of the cylindrical contour along the flying direction from an imaginary plane drawn between the two end edges, i.e., the leading and trailing edges,

of the ABS. Camber has a similar definition and is the separation from an imaginary plane drawn between the two side edges of the slider. For the modern "pico" sliders, these curvature parameters are typically on the order of several nanometers (nm), while the slider width and length are about 1 mm. The curvatures of the ABS are therefore truly minute, however, the variance of the crown and camber of modern sliders remains to be a key factor for the slider performance. Hence, there is an obvious need to develop and implement a method to finely adjust crown and camber.

A variety of techniques are currently being practiced for controlling the slider curvature beyond the capability of conventional lapping. All these techniques rely on inducing a surface stress change (ΔS) on at least one slider surface. This change of surface stress can be (1) positive (i.e., increase of compressive stress) or (2) negative (i.e., decrease of compressive stress). The change in surface stress produces a curvature change in the slider, as shown in Figs.1A and 1B. Fig. 1A shows surface layers having residual compressive stresses in the shaded areas. In Fig. 1B, the surface residual stress on the top surface, assumed to be the flex side, (also called the back side) has been reduced by ΔS, while on the bottom (ABS) side, the residual compressive stress is unchanged. If only one

surface is stress-modified by ΔS, this surface will become more convex or concave if ΔS is positive or negative, respectively. This effect is easy to visualize if the original surface is exactly flat, as shown in Fig. 1A. In this case, the crown change C (which is the "bulging" of the slider ABS as viewed from the y-direction) is simply given by:

$$C = [3(1-\nu)/4E] \ (L/a)^2 \ (\Delta S \ X \ b)$$

where L is the length of the slider, a is its thickness, b is the depth of the surface stress layer, ν is Poisson's ratio, and E is Young's modulus. The camber change is also given by a similar equation for the "bulging" of the slider as viewed from the x-direction.

Several techniques for producing positive or negative stress changes on a slider surface are known. Techniques to induce negative stress changes (i.e., reducing the existing compressive stress, or inducing tensile stress on the surface) are usually practiced on the flex side of the slider, in order to produce an increase in the crown or camber at the ABS side. Stress-reducing techniques that can be used at the flex side include "kiss-lapping" or plasma etching, which can remove part or all of the stressed layer on the surface. However, such

processes have characteristics which detract from their use in a commercial environment.

A more recent approach to slider shaping is the use of laser scribing. Using a laser for creating curvature in sliders is found in U.S. Pat. No. 5,982,583 to Strom. It states in Claim 1 the use of a laser to melt and then cool the back surface (here referred to as the flex side) of a slider to add tensile stress which causes tensile stress relief cracks in the back surface, and which causes the air bearing surface to curve thus modifying crown or camber. Strom's tensile stress relief cracks are oriented predominately parallel to the crown curvature axis. The present inventors regard cracks as undesirable, and should be reduced or minimized in number and size so as not to worsen the surface integrity. The presence of such tensile stress cracks as required by the prior art is an indication that excessive laser power is used to melt excessive amounts of material, and such excessive laser power may damage the sensor which is embedded in the ceramic slider material.

Although some presence of micro-cracks are inevitable when the surface is made "tensile", preferably any cracks made by laser processing should be only very microscopic micro-cracks, visible with a Scanning Electron Microscope. Such micro-cracks tend to orient randomly. An improved approach therefore is to minimize any tensile stress cracks.

Consequently, there is a need for an improved method of laser processing of sliders which does not require the introduction of tensile stress relief cracks in slider material.

It is, therefore, an object of the present invention to provide an improved method for creating controllable crown and camber in sliders by using pulsed laser energy in accordance with the present invention to produce specific, controllable minute curvatures, without the required introduction of tensile stress relief cracks. Other objects and advantages will become apparent from the following disclosure.

SUMMARY OF THE INVENTION

The present invention relates to a method and apparatus for producing very high crown and camber curvature in slider materials using a laser processing system which produces fluence, which is variable in a controllable manner, by applying a laser beam to the flex side of the slider material and varying the fluence of the laser beam to form the curvature in the slider material.

A more thorough disclosure of the present invention is presented in the detailed description which follows and the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and, advantages and features of the present invention will be more clearly understood by reference to the following detailed disclosure and the accompanying drawings in which:

Figs. 1 A & B show a side plan view of a block of slider material first with unrelieved compressive stress on both surfaces, and then showing the effect of relief of compressive stress on the upper surface, and the resulting curvature produced;

Fig. 2 shows a block diagram side view of a laser system of the present invention;

Fig. 3 illustrates a detail view of the focal plane of a laser beam as produced by the laser system of the present invention, and further detail views of the beam as found at three positions relative to the focal plane;

Fig. 4 shows a graph of the effect of varying positional relationship between the slider material and the focal plane of the laser;

Fig. 5 shows the appearance of the melt with microscopic cracks with no preferred orientation;

Fig. 6 illustrates the effect of laser scribing as performed by the present invention in changing the crown of a row of sliders;

Fig. 7 illustrates the effect of laser scribing as performed by the present invention in changing the camber of a row of sliders; and

Fig. 8 shows a chart showing the effect of laser beam focusing position on changes in both crown and camber.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a method and apparatus for creating very high crown and camber in sliders by creating controlled tensile stress in the flex side of the sliders using variable pulsed laser fluence to melt the slider material without over-heating the sensor in it and without tensile stress relief cracks of controlled or preferred orientation.

The present inventors have found that the production of very precisely controllable crown in slider material is possible by treatment of the flex side of the slider, when a pulsed laser beam is used in accordance with the present invention. The present invention discloses a method of producing very precise and large crown and camber.

It is first preferred for processing of alumina ceramics, that a pulsed laser having a pulse width between 10 nanoseconds

(10 X 10^{-9}secs.) and 1 microsecond (1 X 10^{-6} secs.) and a repetition rate of 200-300 kHz is used. This is preferred because this range of pulse-widths and repetition rates allows very quick and localized heating of the material at the point of application, limiting the spreading of heat to the surrounding material, which can cause thermal damage to the slider sensors. It also allows melting of material without loss of material through ablation. Continuous wave lasers having application times on the order of milliseconds to seconds are more likely to have damaging effects on the sensitive sensor components, and considered unsuitable for this type of operation. It is of course possible that for other substrate materials, other pulse durations and repetition rates may be preferred, and the method disclosed herein contemplates changes in other parameters to accommodate differences in materials and in batches of materials.

A second parameter of the present invention is the laser fluence. The term "fluence" refers to the surface laser energy density produced by a laser, preferably a pulsed laser, onto a surface area. In the present invention, it is measured in units of energy (or energy/pulse) divided by area. The beam spot size is generally so small, that the fluence will generally lie in the region of Joules/cm^2.

Fluence can be adjusted for maximal performance and control in two primary ways. First, the spot size can remain constant while the energy per pulse is varied, or second, the energy can remain constant while the spot size is varied.

The energy per pulse of a laser can be varied by several different methods. The current to the excitation mechanism can be adjusted, which has an effect on the power output of the laser. However, it is usually necessary to monitor changes in power output during such changes, since it cannot be relied upon that a 10% change in current input will directly produce a corresponding 10% change in the laser output. The process is complicated by the fact that changes in current input can also produce changes in pulse-width, which can have other effects on the process.

The energy of the laser can also be varied by attenuating the beam by using filters, or using devices such as a Liquid Crystal Variable Retarder (LCVR), which changes polarization in an active manner. When used with a polarizer, the LCVR can be used to reduce the power output in a somewhat controllable manner, although very fine control in the range of a few percent is still difficult to achieve.

Alternatively, a preferred manner of controlling the fluence of the laser is by controlling the spot size, an operation which can be easily and inexpensively controlled by

use of a lens which can be adjusted to move the focal plane relative to the slider material, or by moving the slider piece relative to the focal plane. This method of increasing the spot size is preferred because of its simplicity over the traditional method of using an adjustable beam collimating device to decrease the diameter of the laser beam before the focusing lens, which has the effect of increasing the spot size.

Fig. 2 shows the basic components of the laser processing system **10** of the present invention. A pulsed laser **12** which may be pulsed by a number of mechanisms such as a Q-switch (not shown) produces a laser beam **14** which is preferably reflected from a directing optic such as a movable mirror **16** mounted on a tiltable and/or translatable stage **18**. The laser beam may have been conditioned to provide a collimated beam and/or one that has been expanded **15**, by an optional beam expander **19**. The beam **14** or the expanded beam **15** is then directed by a focusing device such as a lens **20** mounted on a translatable stage **22** which can move the stage vertically as the beam **14** or **15** is focused on the substrate **24** surface, which it will be assumed is the flex side **26** of a slider **28**. The slider **28** is placed on a moveable stage **30** which can move in either the horizontal or vertical planes. The movement of movable fixtures, such as the stage **30**, lens mount **22** and/or mirror mount **18** are preferably controlled by a

computer controller **32**. It should be understood that any combination of movable fixtures in this system is possible, so that any or all of the stage **30**, lens mount **22** and mirror mount **18** may be moveable, or that only the lens mount **22** or stage **30** may be moveable. The use of a reflecting mirror is also optional, so that the slider **28** could alternately be placed vertically as seen in Fig. 3.

The slider **28** will be assumed to be placed at the focal plane **34** in Fig. 2, to produce a spot **36**. This is the point at which the beam **14** is most tightly focused and the spot size will be at a minimum. In terms of fluence, this will present the highest energy concentration per unit area. Fig. 3 shows the effect of moving the slider **28** relative to the focal plane **34**. In the -X direction, the slider **28** will be beyond the focal plane **34**, the spot size will increase, and the fluence will decrease. In the +X direction, the slider **28** will be before the focal plane **34**, and once again, the spot size will be increased and the fluence decreased from that found at the focal plane **34**.

In general terms, the lens **20** and lens stage **22**, as well as the movable slider stage **30**, can be thought of as fluence varying devices, since the spot size, and thus the fluence can be varied through their adjustment. Another way of varying the fluence is by adjusting the power output of the laser, which is typically done by reducing the current to the excitation

mechanism (not shown) of the laser. Examples would include decreasing the current to diodes or flashlamps in diode-pumped or flashlamp-pumped lasers, or controlling the voltage to an excimer laser's excitation mechanism.

Fig. 4 illustrates a chart showing the measured change in crown as a function of slider position with respect to the focal plane, which is identified as 0.0 position, where the spot size is minimum, and the fluence at maximum. The laser used was operated at a 100kHz repetition rate. Two curves are shown, one representing a 2.0 Watt output shown with circles, and a 1.75 Watt output indicated by triangles. The distances from the focal plane which produced the most change in the slider crown are noted with arrows and marked as "optimal fluence" on the chart. At these points the performance of the laser system has been optimized so that, for example, for a pulsed laser operating at 100kHz and producing 2 Watts of power, or 20 micro-joules per pulse, by locating the slider at either -1.25mm or +1.5mm from the focal plane, the laser beam will melt the slider material just enough to induce the maximum tension stress, and thus the maximum curvature in the slider material, when it refreezes. The safety of the sensor is also thus assured, because pulses of this duration and energy level will not heat the surrounding substrate so as to cause damage.

The typical appearance of the melt after laser irradiation of the slider material is shown in Fig. 5, which is a scanning electron microscope image of the melt on a slider surface, viewed at an angle of 45 degrees from normal. The top part of the figure, which is the surface orthogonal to the surface which has been melted, shows a cross-section of the melt zone, which is of sub-micron thickness. The micro-cracks do not have particular orientation and are typically sub-micrometers in depth.

As defined above, crown is the maximum separation of the cylindrical contour along the flying direction from an imaginary plane drawn between the two end edges, i.e., the leading and trailing edges, of the ABS. Camber is the separation from an imaginary plane drawn between the two side edges of the slider. As shown in Fig. 6, crown **46** is shown being produced in a row of sliders **38** having their leading edges **40** and their trailing edges **42** at the top and bottom respectively of the Figure. The flex sides **26** of the sliders **28** are facing the viewer, and in this orientation, optimized crown is produced by scribing parallel horizontal lines **46**. As shown by the dashed line, the row of sliders **38** is assumed to have an initial crown **46** which is negative, i.e. convex as seen by the viewer of the Figure, typically due to unrelieved compressive stress in the material.

The final crown **48** is seen to be positive, i.e. concave as seen from the flex side **26**.

In a similar way, Fig. 7 shows a row of sliders **38** having vertical scribed lines **50**. The initial camber **52** and the final camber **54** are shown as the result of the laser processing.

Fig. 8 shows a chart of the change in both crown and camber in nanometers and includes the data shown in Fig. 4, plotted against the actual laser beam focusing position. The crown and camber changes are obtained at various laser power levels and for various spot sizes as they are changed from a minimum of 36 X 10^{-6} meter beam diameter at the focal plane, labeled to be at 8.0 mm on the chart. It can be seen that the maximum curvature change corresponding to optimal fluence is found when the slider is positioned at either before or after the position of the focal plane.

In addition to the use of a fundamental laser wavelength from a Nd-doped solid-state laser, it is possible that the laser beam is produced through a process of harmonic generation to yield a wavelength which is absorbed well by the substrate material, as disclosed in pending U.S. patent application Ser. No. 09/444793, filed 11/22/99, entitled PROCESSING OF MULTI-PHASE CERAMIC SLIDER MATERIALS USING HARMONICALLY GENERATED ULTRAVIOLET LASER RADIATION.

Although this invention has been described with respect to specific embodiments, the details thereof are not to be construed as limitations, for it will be apparent that various embodiments, changes and modifications may be resorted to without departing from the spirit and scope thereof; and it is understood that such equivalent embodiments are intended to be included within the scope of this invention.

CLAIMS

While various embodiments have been described above, it should be understood that they have been presented by way of example only, and not limitation. Thus, the breadth and scope of a preferred embodiment should not be limited by any of the above described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.

What is claimed is:

1. A method for producing very high crown and camber curvature in slider materials having a flex side and an air-bearing side using a laser processing system which produces a pulsed laser beam, comprising the steps of:

(A) establishing a focal plane for the laser beam, the laser beam having a pulse width in the range of 1×10^{-9} seconds to 1×10^{-3} seconds, with an energy per pulse in the range of 1 to 1,000,000 microJoules, and a repetition rate between 1Hz and 400 kHz;

(B) applying the pulsed laser beam to the flex side of the slider material; and

(C) varying the relative positions of the slider material and the focal plane of the laser beam to optimize the curvature.

2. The method of claim 1, wherein the laser processing system further comprises a focusing device, whereby the focal plane of the laser beam is established.

3. The method of claim 2, wherein said focusing device is at least one lens mounted on a moveable stage, whereby the position of the focal plane relative to the slider material can be varied.

4. The method of claim 1, wherein the laser processing system further comprises a movable stage to which the slider material is attached, the position of the slider material relative to the focal plane can be varied.

5. The method of claim 1, wherein the laser is Q-switched.

6. The method of claim 1, wherein the laser beam is conditioned with a beam expander with adjustable beam expansion.

7. The method of claim 1, wherein the laser beam is produced through harmonic generation.

8. The method of claim 1, wherein the laser beam is moved by at least one directing optic.

9. The method of claim 8, wherein at least one directing optic includes at least one reflecting mirror.

10. The method of claim 1, wherein the slider material is one or more rows of sliders.

11. A method for producing very high crown and camber curvature in slider materials having a flex side, using a laser processing system which produces a laser beam which produces fluence which is variable in a controllable manner, comprising the steps of:

(A) applying the laser beam to the flex side of the slider material, the laser beam having a pulse width in the range of 1 X 10^{-9} seconds to 1 X 10^{-3} seconds, with an energy per pulse in the range of 1 to 1,000,000 microJoules, and a repetition rate between 1Hz and 400 kHz; and

(B) varying the fluence of the laser to optimize the curvature in the slider material.

12. The method of claim 11, wherein fluence is controllably varied by changing the power output of the laser.

13. The method of claim 11, wherein fluence is controllably varied by changing the spot size of the laser beam.

14. The method of claim 13, wherein the spot size of the laser beam is varied by changing the relative positions of the slider material and the focal plane of the laser beam.

15. The method of claim 14, wherein the spot size is controllably varied by moving the focal plane of the laser beam relative to the slider material.

16. The method of claim 15, wherein the focal plane of the laser is moved relative to the slider material by using at least one focusing lens which is attached to a movable mount.

17. The method of claim 14, wherein the slider material is moved relative to the focal plane of the laser by using a movable mount to which the slider material is attached.

18. The method of claim 11, wherein fluence is controllably varied by adjusting the beam expansion of the laser beam.

19. The method of claim 11, wherein the slider material is one or more rows of sliders.

20. An apparatus for creating high crown and camber curvature in slider materials having an air bearing surface and a flex side, comprising:

a laser which produces a pulsed laser beam for machining the slider material, the laser beam having a pulse width in the range of 1 X 10^{-9} seconds to 1 X 10^{-3} seconds, with an energy per pulse in the range of 1 to 1,000,000 microJoules, and a repetition rate between 1Hz and 400 kHz;

at least one beam directing device, which directs the laser beam onto the flex side of the slider material; and

a fluence varying device so that optimal fluence is achieved to produce optimal curvature.

21. The apparatus of claim 20, wherein:

the fluence varying device is at least one focusing lens which directs the laser beam to focus within a focal plane and a movable fixture which varies the position of the slider material with respect to the focal plane.

22. The apparatus of claim 21, wherein:

the movable fixture is a movable stage upon which the slider material is attached, and by which the slider material is moved relative to the focal plane.

23. The apparatus of claim 21, wherein:

the movable fixture is a movable stage upon which the lens is attached, and by which the focal plane is moved relative to the slider material.

24. The apparatus of claim 20, wherein the laser is Q-switched.

25. The apparatus of claim 20, wherein the laser beam is produced through harmonic generation.

26. The apparatus of claim 20, wherein the laser beam is moved by at least one directing device.

27. The apparatus of claim 26, wherein at least one directing optic includes at least one reflecting mirror.

28. The apparatus of claim 20, wherein the laser beam is conditioned with a beam expander that has adjustable beam expansion.

29. The apparatus of claim 20, wherein the slider material is one or more rows of sliders.

30. A slider having optimized crown or camber curvature prepared from substrate material having an air-bearing side and a flex side, prepared by a process using a laser which produces a pulsed laser beam, the laser beam having a pulse width in the range of 1×10^{-9} seconds to 1×10^{-3} seconds, with an energy per pulse in the range of 1 to 1,000,000 microJoules, and a repetition rate between 1Hz and 400 kHz, the process comprising the steps of:

(A) applying the laser beam to the flex side of the substrate material; and

(B) varying the fluence of the laser beam to optimize the curvature in the substrate material.

31. A slider prepared by the process of claim 30, wherein fluence is controllably varied by changing the power output of the laser.

32. A slider prepared by the process of claim 30, wherein fluence is controllably varied by changing the spot size of the laser beam.

33. A slider prepared by the process of claim 32, wherein the spot size of the laser beam is varied by changing the position

of the substrate material relative to the focal plane of the laser beam.

34. A slider prepared by the process of claim 32, wherein the spot size is controllably varied by changing the position of the focal plane of the laser beam relative to the substrate material.

35. A slider prepared by the process of claim 34, wherein the focal plane of the laser is moved relative to the substrate material by using at least one focusing lens which is attached to a movable mount.

36. A slider prepared by the process of claim 30, wherein the laser beam is conditioned with a beam expander that has adjustable beam expansion.

37. A slider prepared by the process of claim 30, wherein the substrate material is one or more rows of sliders, which are then separated to produce individual sliders.

SLIDER CURVATURE MODIFICATION BY SUBSTRATE MELTING EFFECT PRODUCED WITH A PULSED LASER BEAM

ABSTRACT OF THE INVENTION

A method and apparatus for producing very high crown and camber curvature in slider materials using a laser processing system which produces fluence which is variable in a controllable manner, by applying a laser beam to the flex side of the slider material and varying the fluence of the laser beam to optimize the curvature in the slider material. The fluence is variable by finely controlling the power output of the laser or by changing the spot size of the laser beam. The beam spot size can be changed by using a focusing lens to establish a focal plane and then varying the relative positions of the slider relative and the focal plane.

An apparatus for producing high crown and camber is also disclosed, as well as a slider produced by the process of applying a laser beam to the flex side of the slider material and varying the fluence of the laser beam to optimize the curvature in the slider material.

SLIDER CURVATURE MODIFICATION BY SUBSTRATE MELTING EFFECT PRODUCED WITH A PULSED LASER BEAM

Inventor: CHANG, Ping Wei, et. al.

Atty. ref.: IBM1P005, IBM ref.: SJ00000019US1

THIS CORRESPONDENCE CHART IS FOR EASE OF UNDERSTANDING AND INFORMATIONAL PURPOSES ONLY, AND WILL NOT BE SUBMITTED AS A PART OF THE FORMAL PATENT APPLICATION.

10 laser system
12 pulsed laser
14 laser beam
15 expanded laser beam
16 movable mirror
18 mirror stage
19 adjustable beam expander
20 lens
22 lens stage
24 substrate
26 slider flex side
28 slider
30 slider stage
32 computer controller
34 focal plane
36 crown
38 row of sliders
40 leading edge
42 trailing edge
44 horizontal scribed lines
46 initial crown
48 final crown
50 vertical scribed lines
52 initial camber
54 final camber

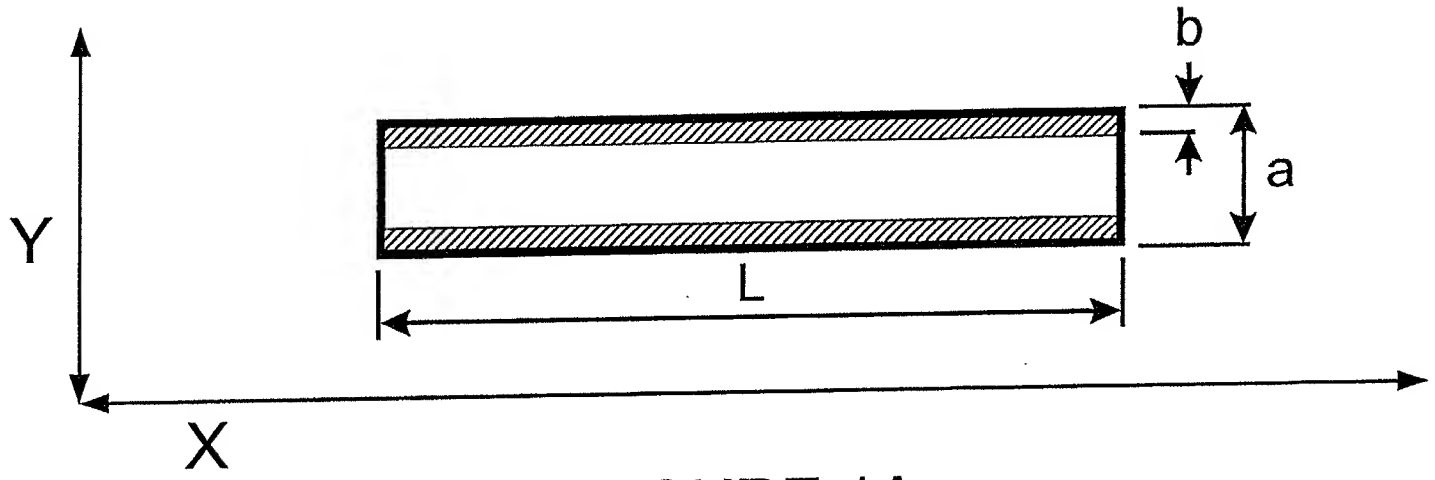
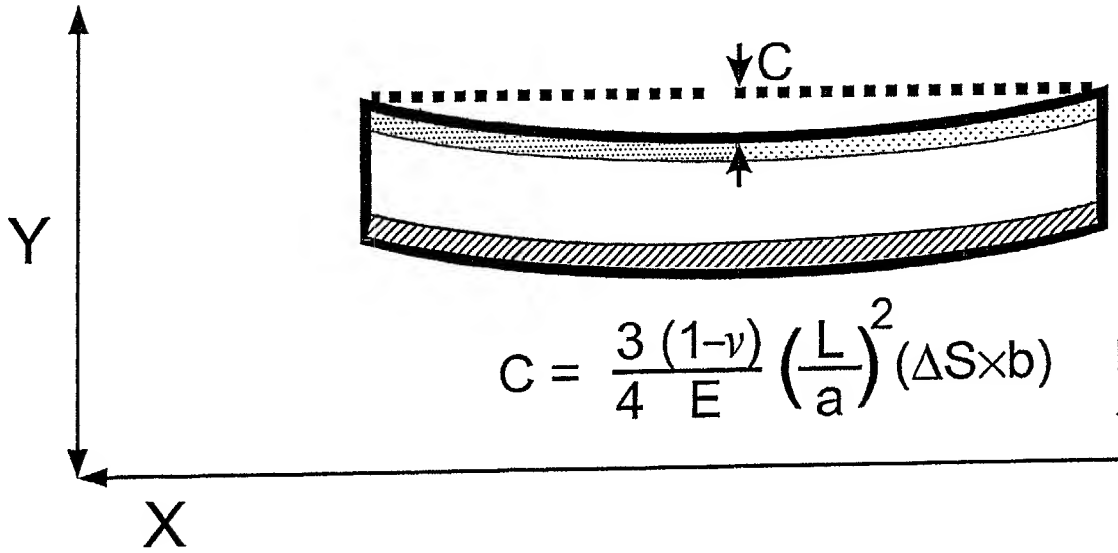


FIGURE 1A



$$C = \frac{3\,(1-\nu)}{4\;E}\left(\frac{L}{a}\right)^2(\Delta S \times b)$$

ΔS stress change
E Young's modulus
ν Poisson's ratio

FIGURE 1B

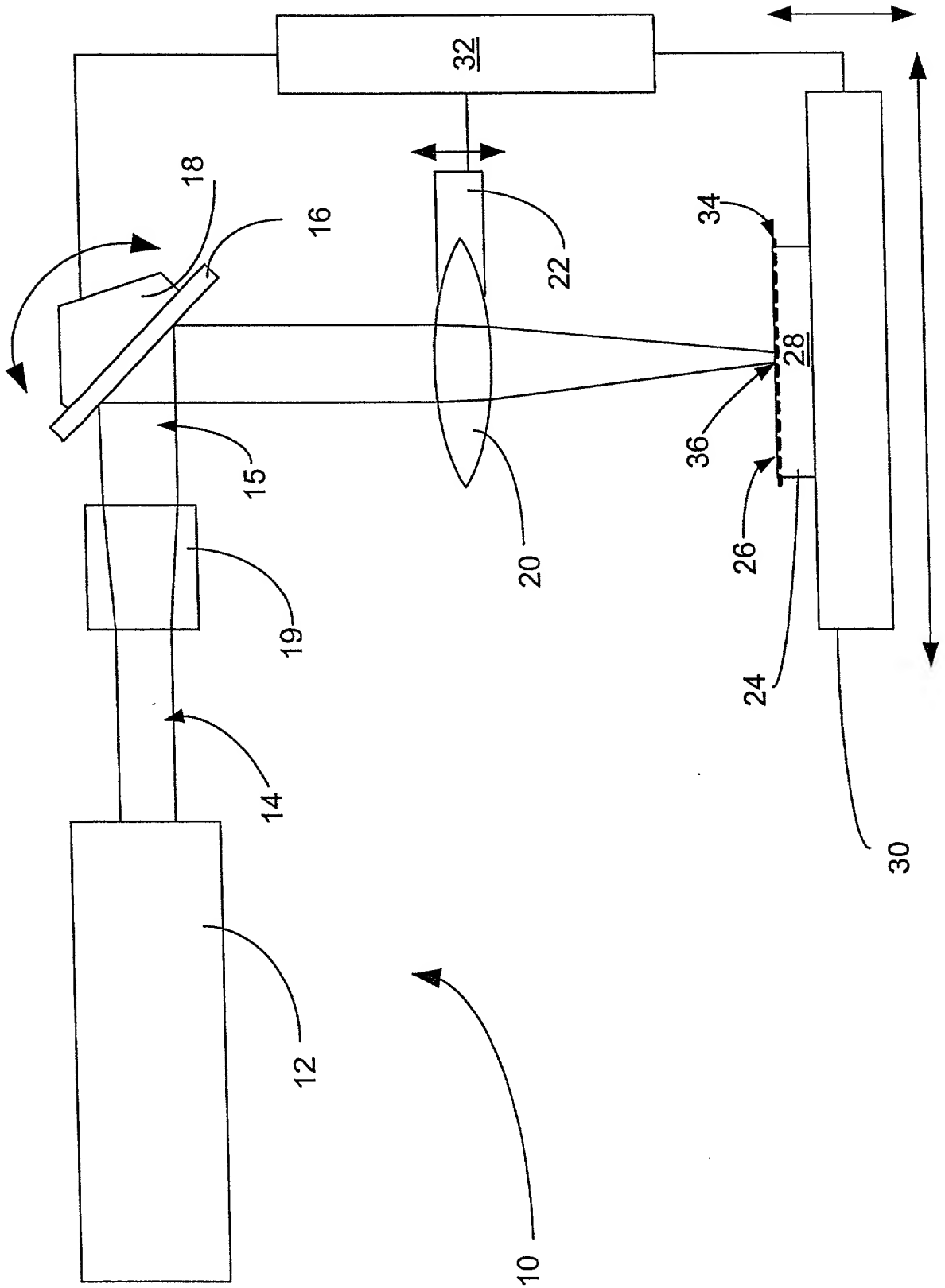


FIGURE 2

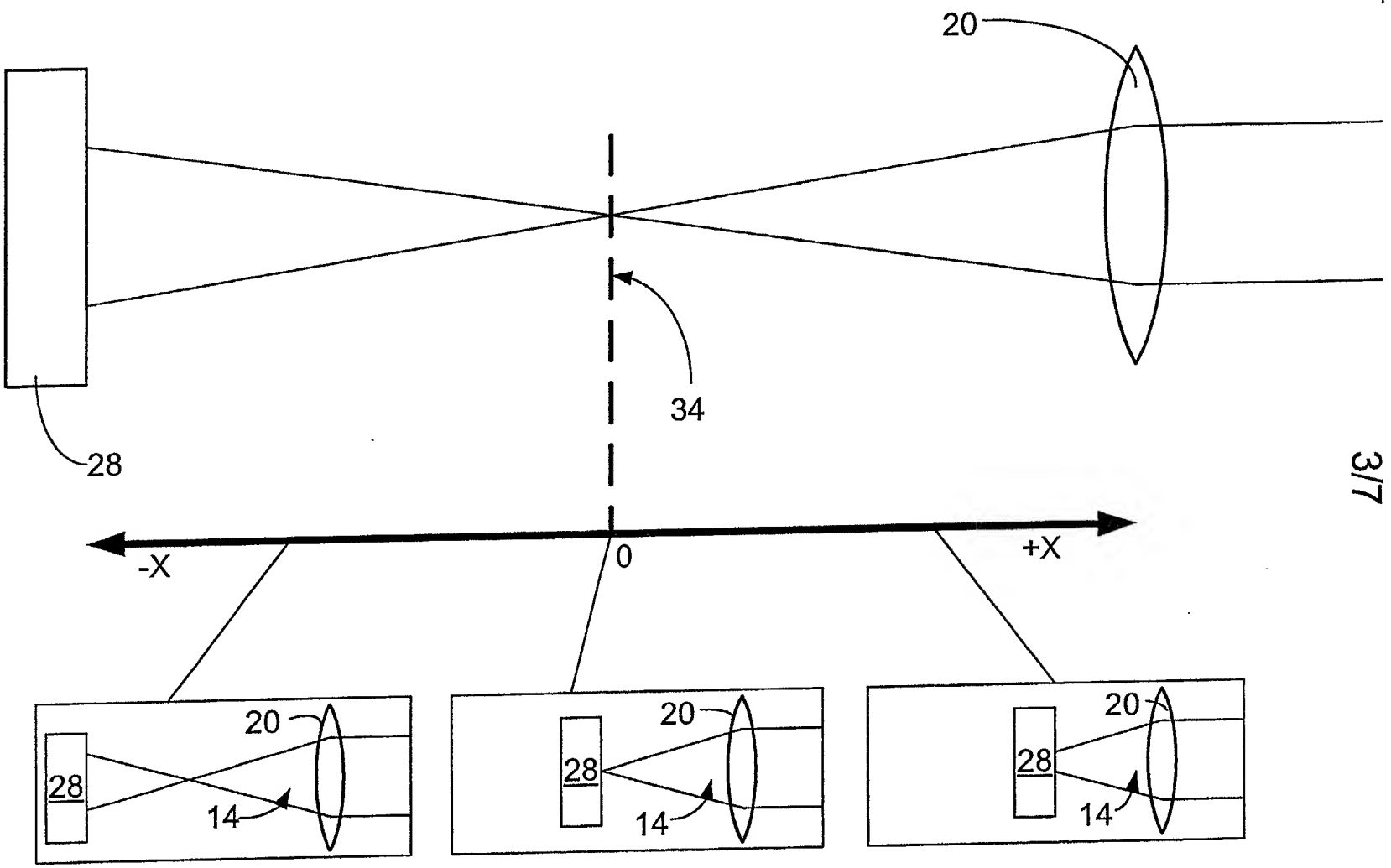


FIGURE 3

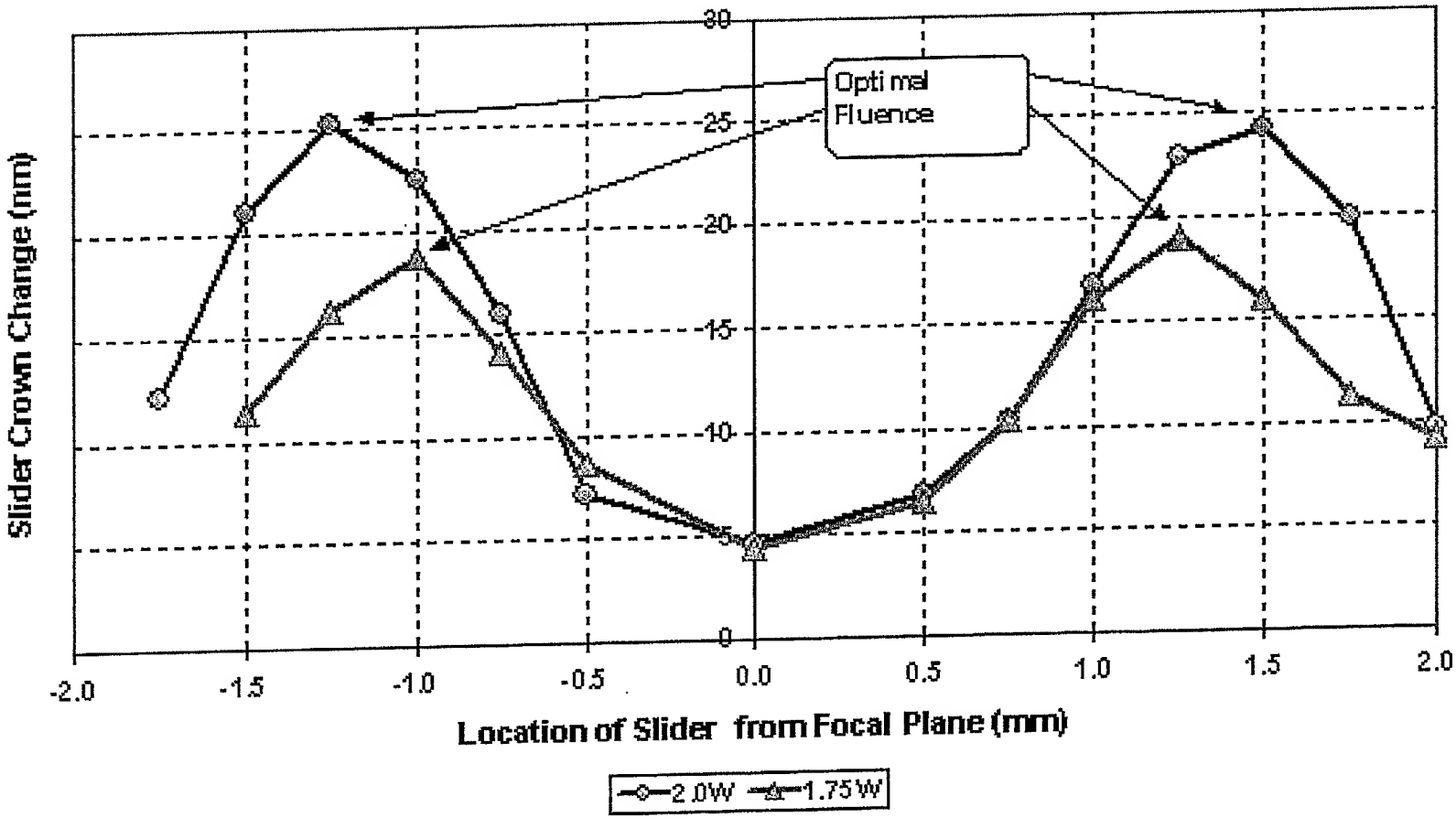

Slider Crown Change (nm)
30
25
20
15
10
5
0
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
Location of Slider from Focal Plane (mm)
Optimal Fluence
2.0W
1.75W

FIGURE 4

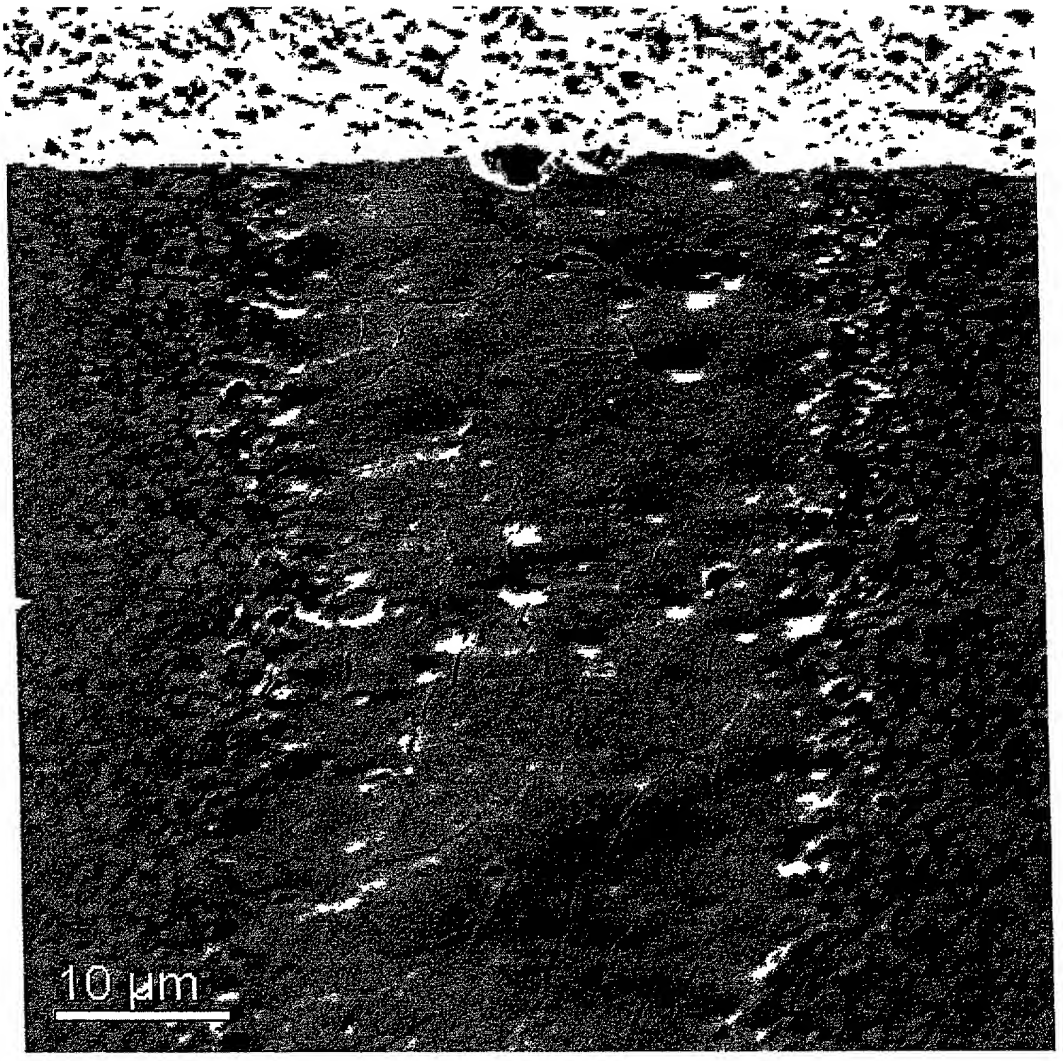


FIGURE 5

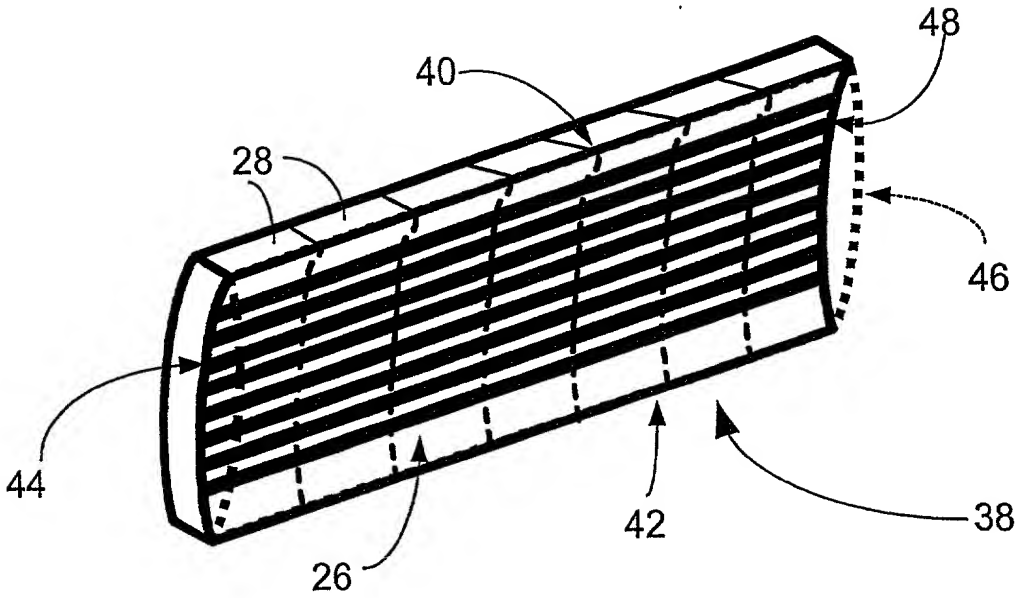


FIGURE 6

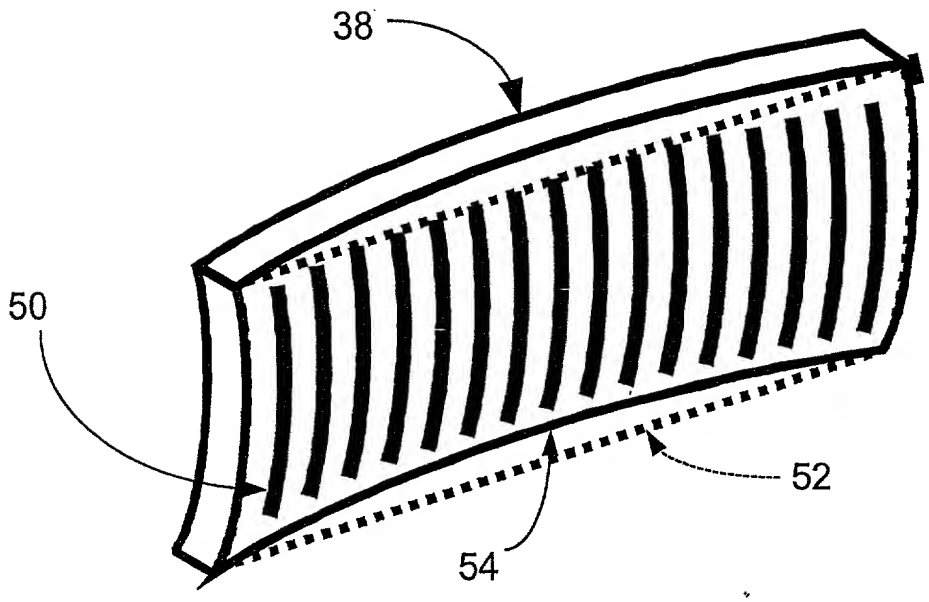


FIGURE 7

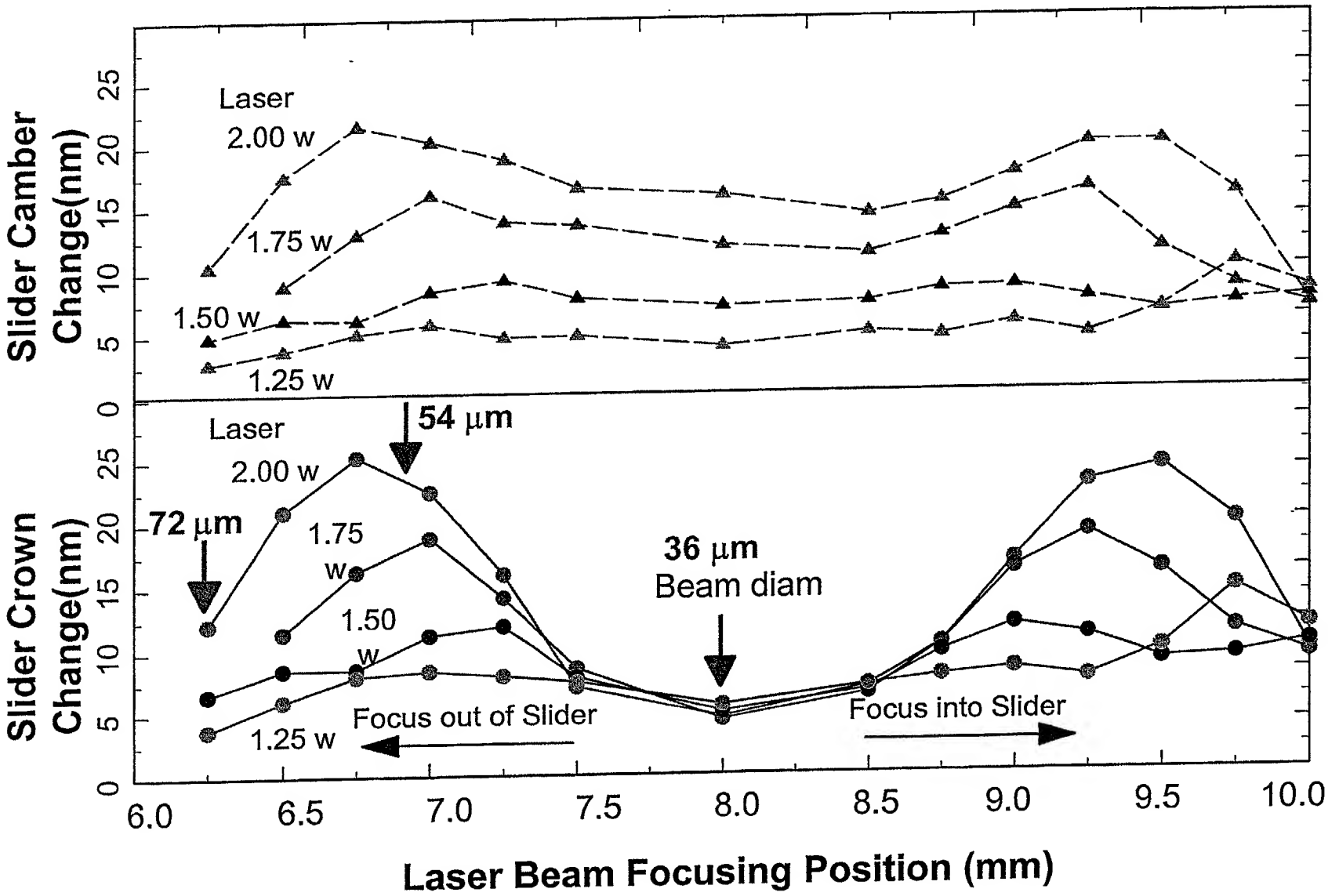

Slider Camber Change(nm)
Laser
2.00 w
1.75 w
1.50 w
1.25 w
Slider Crown Change(nm)
Laser
2.00 w
1.75 w
1.50 w
1.25 w
54 µm
72 µm
36 µm
Beam diam
Focus out of Slider
Focus into Slider
0
5
10
15
20
25
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
Laser Beam Focusing Position (mm)

FIGURE 8

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION **DOCKET: SJ0000019US1**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SLIDER CURVATURE MODIFICATION BY SUBSTRATE MELTING EFFECT PRODUCED WITH A PULSED LASER BEAM

the specification of which (check one)

__X__ is attached hereto.
____ was filed on _____
as Application Serial No. _____
and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
None			___Yes	___No
(Number)	(Country)	(Day/Month/Year Filed)		

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56, which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

None		
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION **DOCKET: SJ09-2000-0013**

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Esther E. Klein (#34,337)
G. Marlin Knight (#33,409)
Paik Saber (#37,494)
Christopher A. Hughes (#26,914)
John E. Hoel (#26,279)
Robert B. Martin (#26,945)
Larry B. Guernsey (#40,008)
Paul L. Hickman (#28,516)
Michael J. Hughes (#29,077)
Joseph F. Villella Jr. (30,599)
William D. Gill (44,124)
Douglas R. Millett (#31,784)
Abdy Raissinia (#38,636)
Edward A. Pennington (#32,588)
Joseph C. Redmond, Jr. (#18,753)
Randall J. Bluestone (#40,518)
L. Ketih Stephens (#32,632)
Brian R. Coleman (#39,145)

Send correspondence to:

Larry B. Guernsey
Hickman Stephens Coleman & Hughes LLP
P. O. Box 52037
Palo Alto, California 94303

Direct Telephone Calls to: (name and telephone number) Larry Guernsey, (408) 558-9887

Full name of sole or first joint-inventor: Andrew Ching Tam

Inventor's signature: Andrew Tam Date: June 1, 2000

Residence: **21463 Continental Circle, Saratoge, California 95070**

Citizenship: U.S.

Post Office Address: Same

Full name of second joint-inventor: Chie Ching Poon

Inventor's signature: Chie Ching Poon Date: JUNE 1, 2000

Residence: 6694 Elwood Road, San Jose, California 95120

Citizenship: U.S.

Post Office Address: Same

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION **DOCKET: SJ09-2000-0013**

Full name of third joint-inventor: Ping-Wei Chang

Inventor's signature:  Date: June 1, 2000

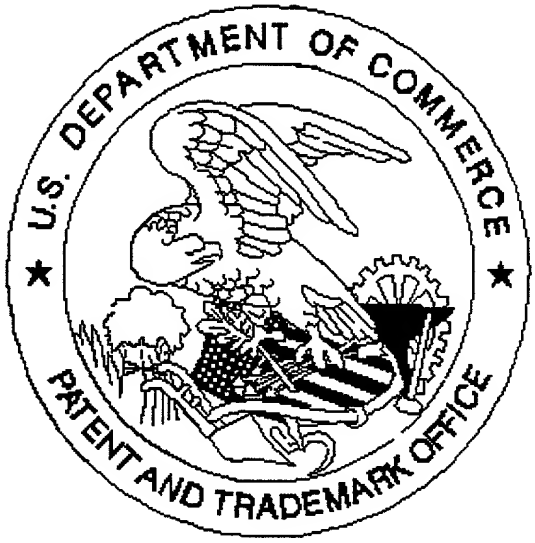
Residence: **1610 Elmar Way, San Jose, California 95129**

Citizenship: Taiwan

Post Office Address: Same

United States Patent & Trademark Office

Office of Initial Patent Examination -- Scanning Division



Application deficiencies were found during scanning:

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